J. Raptor Res. 22(1):3–7

TURKEY VULTURE SURVEYS IN CUBA

Carlos Wotzkow and James W. Wiley

Abstract.—Turkey Vultures (*Cathartes aura*), were surveyed monthly in Cuba from March 1982–January 1983. A total of 25 371 vultures were tallied in 7186 km (3.5 vultures/transect km) of roadside counting along main highways leading from the city of La Habana (northwestern Cuba) to the city of Las Tunas (southeast). Numbers of vultures counted declined substantially beyond 200 m from the transect road. Density of vultures observed within 200 m of the road along the transect route was 0.06/ha. Highest counts were obtained in March, April and June. Turkey Vulture flying activity was greatest during the periods 0900–1200 H and 1400–1700 H.

In recent years Turkey Vulture (*Cathartes aura*) numbers have declined in parts of North America (Brown 1976; Wilbur 1983; Alvarez del Toro and Phillips *in* Wilbur 1983). Ellis et al. (1983) reported Turkey Vultures common over most of Latin America in 1978 and 1979, and Webster (1975, 1978) suggested that numbers of wintering Turkey Vultures have increased in the lower Río Grande valley of Texas. Wilbur (1983) characterized the Turkey Vulture as an abundant species, but one that should be carefully monitored. Aside from the studies of Santana et al. (1986a, 1986b), little is known of Turkey Vultures in the West Indies. Populations in Puerto Rico and Hispaniola may have been introduced from Cuba (Wetmore 1916; Garrido and Garcia Montaña 1975; Dod 1978), although Santana et al. (1986a) argue that vultures arrived in the southern Greater Antilles by natural range expansion once forests were cleared and livestock was introduced by European colonists in the 1800s. The species is common in all regions of Cuba, as well as on the Isle of Pines (Isle of Youth) and coastal cays (Garrido and Garcia Montaña 1975).

Our objectives were: 1) to collect vulture population data along established routes to serve as a baseline for comparison with future surveys and in determining long-term trends in vulture populations in Cuba; 2) to conduct a preliminary study of seasonal trends in vulture detectability; and 3) to determine activity patterns of vultures in Cuba.

Study Area and Methods

We used a "road count" method (reviewed in Fuller and Mosher 1981, 1987; see also Ellis et al. 1983; Hubbard 1983; Andersen et al. 1985) to conduct 11 surveys along a 670.5 km transect route (public highways) at monthly intervals beginning in March 1982 and ending in January 1983 (Table 1). The route extended from La Habana (Havana) on the northwestern coast 268 km to the southeast through the interior to Santa Clara (Villa Clara Province) and continued 402.5 km to the southeast through the interior along the Carretera Central ("Central Highway") from Santa Clara to Victoria de las Tunas (Fig. 1). Surveys were discontinued while passing through towns and cities, thus counts were made along 654 km of the route (Table 1; the June 1982 count was reduced to 652 km due to rain). One observer (CW) conducted each survey.

Most of the transect route passed through flat, cultivated lands or rolling hills of <200 m elevation, interspersed with remnant savannas of royal palm (*Roystonea regia*) and silk-cotton-tree (*Ceiba pentandra*) or royal palm and saman (*Pithecellobium saman*) and dry brush- and woodlands. View was largely unobstructed, although a small section has low secondary brush. However, the Carretera Central passes through some woods and hills which reduced detection distances.

Annual average temp along the survey route fluctuates between 23°C and 26°C, with extremes of 1°C and 38°C (Instituto Cubano de Geodesia y Cartografía 1978). Average summer temp ranges from 25°–28°C with July and August being the warmest months. Average winter temp ranges from 21°–24°C with the lowest temp in February. Annual rainfall averages 1000–1600 mm. May through October is the period of greatest rainfall (average 800–1200 mm); November through April is the dry season (200–400 mm).

Surveys were conducted using public transportation (bus, car or truck) at an average speed of 72.7 km/hr along the route. Surveys took approximately nine hr to complete and most surveys were conducted on two different days, resulting in the second part of the survey being an average of three d (range one–nine) after the first (Table 1). Surveys were completed in one d in August and November 1982 and in January 1983. Vultures were counted on both sides of the road and numbers tabulated in one of 14 horizontal distance (m) categories from the road as follows 0–25, 26–50, 51–100, 101–150, 151–200, 201–250, 251–300, 301–350, 351–400, 401–450, 451–500, 501–550, 551–600, and >600 m. However, these increments proved to be too narrow for the level of observer accuracy attained during the surveys. We later modified distance categories (and combined earlier observations) as follows: 0–100, 101–200, 201–400, 401–600, and >600 m.

Activity and time of day were noted for each vulture

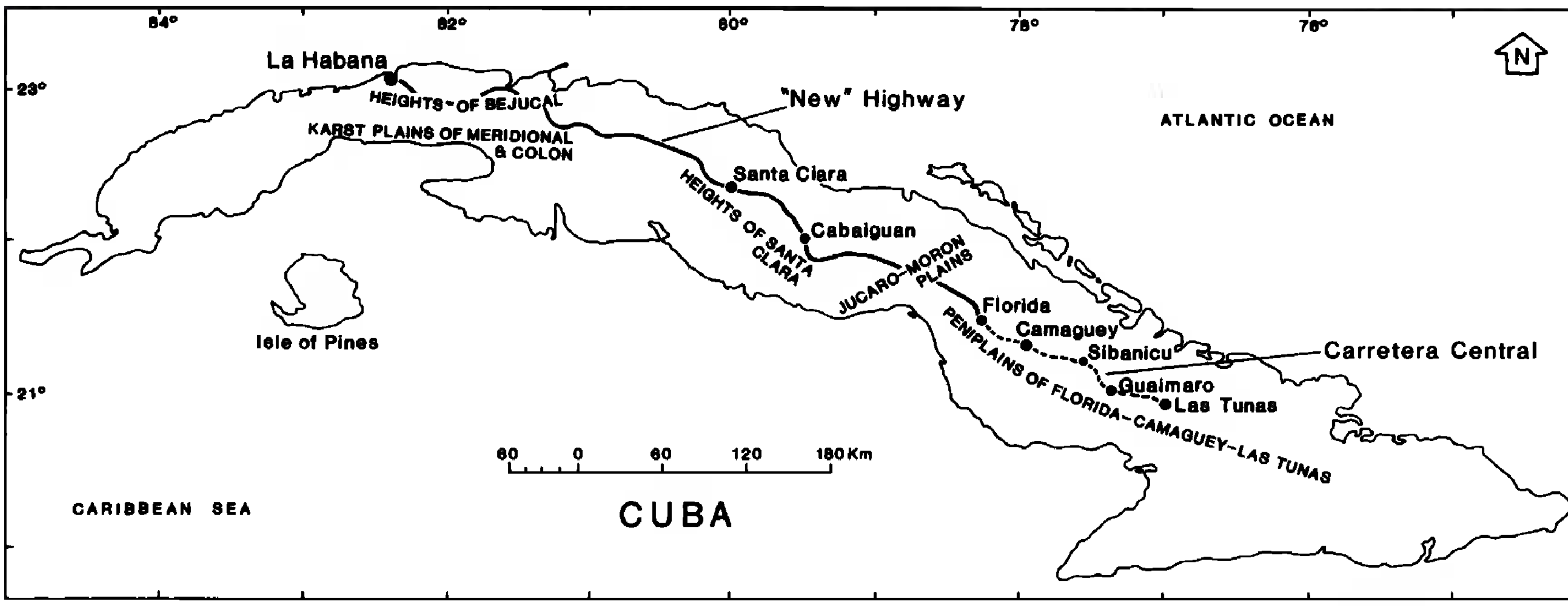

Figure 1. Turkey Vulture survey route along the "New Highway" and Carretera Central in Cuba, and major geographic features along route.

sighted. Flying activity was weighted according to sampling effort because all periods were not sampled equally. General weather conditions (clear, partly cloudy, complete cloud cover, rain; wind conditions) were recorded. Counts were not made during periods of poor visibility.

Individual transects were divided into seven equal segments (93 km each) to estimate variances of vultures observed within surveys and to allow statistical comparisons among the surveys. Also, numbers of vultures observed were compared among six regions (range 50–100 km in

Table 1. Summary of Turkey Vulture transect conditions and chronology, La Habana to Victoria de las Tunas, Cuba, March 1982–January 1983.

Survey		Transect							
		Start		Finish		Distance (km)	Survey Time (hr)	Mean Speed (km/hr)	Weather Index[b]
No.	Date	Town	Time[a]	Town	Time[a]				
1	22 Mar	La Habana	0815	Camagüey	1755	536	7.5	72.0	4.5
	25 Mar	Las Tunas	0730	Camagüey	1250	114	1.8	64.0	5.0
2	8 Apr	La Habana	0730	Sibanicú	1735	582	7.8	74.6	2.0
	12 Apr	Las Tunas	1010	Sibanicú	1155	72	1.2	72.7	2.0
3	26 May	Santa Clara	0905	Las Tunas	1600	384	5.2	73.9	4.0
	29 May	Santa Clara	1230	La Habana	1640	268	4.2	64.3	4.0
4	12 Jun	La Habana	1315	Santa Clara	1640	268	4.3	63.1	4.0
	16 Jun	Las Tunas	1000	Santa Clara	1702	384	4.9	78.9	5.0
5	5 Jul	La Habana	0745	Guáimaro	1805	612	8.3	73.4	5.0
	7 Jul	Las Tunas	1020	Guáimaro	1101	42	0.7	60.0	3.0
6	13 Aug	La Habana	0600	Las Tunas	1718	656	9.5	69.0	4.0
7	20 Sep	Las Tunas	1020	Santa Clara	1710	384	4.9	78.4	4.0
	29 Sep	Santa Clara	0830	La Habana	1215	268	3.8	75.6	5.0
8	8 Oct	La Habana	0900	Sibanicú	1810	582	7.1	82.0	3.0
	11 Oct	Las Tunas	0800	Sibanicú	0907	72	0.9	77.4	4.5
9	29 Nov	Las Tunas	0900	La Habana	1845	654	8.4	77.9	3.0
10	20 Dec	La Habana	0900	Camagüey	1758	540	6.9	78.8	3.5
	24 Dec	Las Tunas	0952	Camagüey	1133	114	1.4	80.3	3.0
11	8 Jan	La Habana	0615	Las Tunas	1702	654	9.4	69.6	1.0

[a] Eastern time zone.
[b] Weather index: 5 = clear, 4 = mostly clear, 3 = mostly cloudy, 2 = complete cloud cover, 1 = complete cloud cover with occasional rain.

length) which reflected differences in habitat along the survey route.

Parametric analyses were used unless data were non-normal; in those cases, nonparametric tests were applied. Chi-square goodness of fit tests (Zar 1974:80–81) were used to determine normality. Analysis of variance (ANOVA) and Spearman rank correlation coefficients (r_s) follow Zar (1974). Significance level was set at 0.05.

RESULTS AND DISCUSSION

Weather during the surveys was mostly clear (Table 1); only one short period of rain precluded data collection along a two km section of the route during June 1982. Wind speed was consistently low (i.e., ≤20 kph) during the surveys. We found a moderate correlation between sky conditions and number of vultures counted; i.e., fewer vultures was seen on cloudy than on clear days (r_s = 0.3890, df = 18, 0.05 < P < 0.10). A total of 7186 km were surveyed in 11 counts, with a total of 25 371 vulture sightings. An average of 2306.5 (±623.19 S.D.) vultures/survey were sighted (range = 1503–3363; Table 2), or an average of about 3.5/transect kilometer. Santana et al. (1986a) reported substantially fewer vultures (means for four transect segments ranged from 0.002–0.9/km) from roadside counts in southwestern Puerto Rico, as did Hubbard (1983) in New Mexico (0.03/km).

We noted peaks in March, April and June numbers of birds observed (Table 2). Counts were substantially lower during the periods July–October and December–January (ANOVA; F = 9.56, df = 10, 66; P < 0.01). However, our small sample size (single monthly surveys) and the variation in sky conditions do not allow a realistic evaluation of seasonal variation in vulture numbers. Sky conditions were poor (complete cloud cover) in January, and only fair (mostly cloudy) during the December count, which might explain the low numbers of birds counted during those surveys. However, the weather was good to excellent (clear or mostly clear) during the July–October surveys (Table 1). Although Turkey Vultures have not been reported as migratory in Cuba previously (Wilbur 1983), two birds marked (patagial color streamers) in south Florida have been observed near La Habana (Wotzkow, pers. observ.). Such movements, along with possible local movements in response to seasonal food distribution, may have influenced local numbers of vultures along our survey route. Breeding season for Turkey Vultures has not been clearly defined for West Indies populations, but nests have been found in Cuba in February (eggs), April (older nestlings), and May (young nestlings) (Davis 1941; Jackson 1983). Thus, low counts in July, August and October were not likely due to parental attendance at nests.

Table 2. Results of surveys for Turkey Vultures, La Habana to Victoria de las Tunas, Cuba, March 1982–January 1983.

SURVEY NO.	MONTH	NUMBER VULTURES SIGHTED		NUMBER VULTURES/ KM
1	March	3363		5.2
2	April	2726		4.2
3	May	2369		3.6
4	June	3358		5.2
5	July	1649		2.5
6	August	1924		2.9
7	September	2384		3.7
8	October	1917		2.9
9	November	2141		3.3
10	December	2037		3.1
11	January	1503		2.3
	Total	25 371	Mean	3.5

Vulture flight activity differed during the day. Activity was low before 0800 H, and declined substantially after 1800 H (Fig. 2). Two peak periods of activity were observed: one between 0900 H and 1200 H and a second between 1400 H and 1700 H.

Number of vultures observed was inversely related to the distance from the transect line (r_s = −0.900, P < 0.01). Observations of vultures declined substantially beyond 200 m, suggesting that detection was less likely beyond that distance (Fig. 3). The number of vultures observed within 201–400 m from the transect was about 32% less than the numbers detected in closer ranges. Numbers of vultures observed within 401–600 and >600 m from the transect were only 13.1% and 6.4% of the number we counted within 200 m. An alternative explanation to birds being less detectable at distances >200 m may be that vultures concentrated along roads for food (i.e., road kills). A check study is needed to determine if vultures are clustered along roads and to verify error rates of placing observations into distance segments away from the transect line.

Vulture abundance (and detectability) were analyzed among the six segments of the transect that reflected habitat differences. Vulture counts were weighted to compensate for reduced flying activity

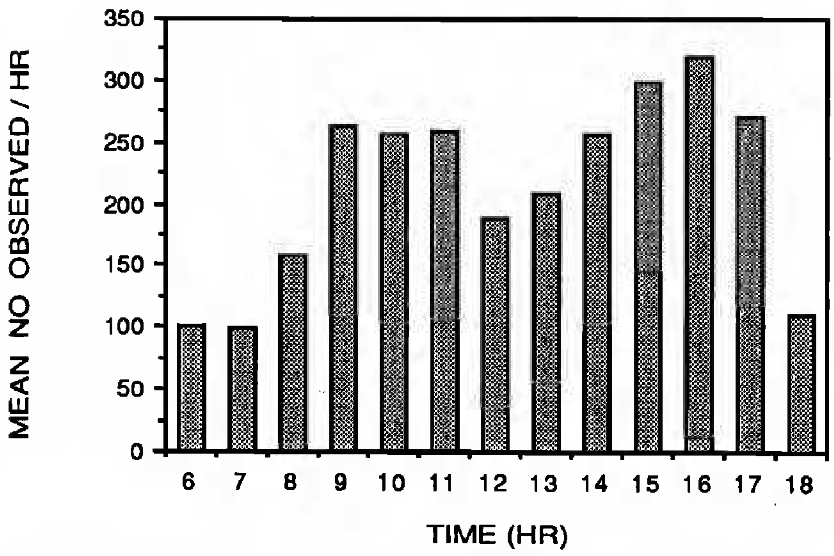

Figure 2. Turkey Vulture activity, expressed as mean number of birds (N = 25 371) observed per hour through day during 11 roadside surveys in Cuba, March 1982–January 1983.

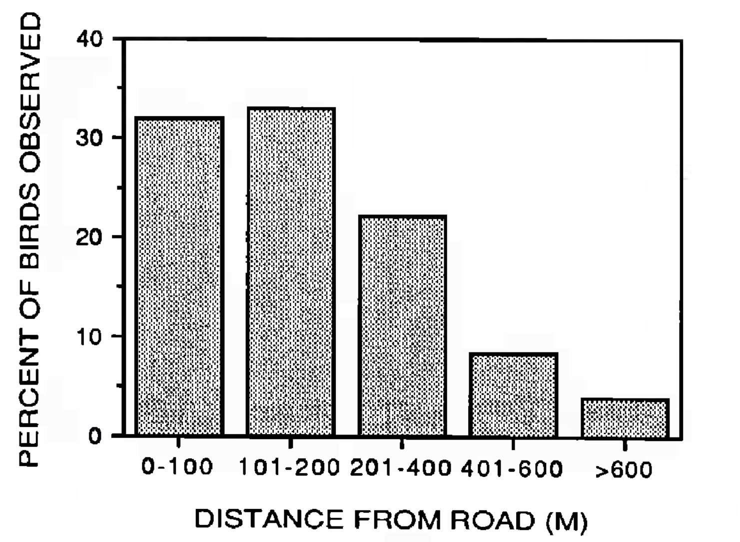

Figure 3. Percent of Turkey Vultures (N = 25 371) observed within five distance segments during 11 surveys in Cuba, March 1982–January 1983.

(thus increased visibility) before 0900 H, between 1200–1400 H, and after 1700 H. Vultures counted within the six regions along the survey route differed (ANOVA; F = 9.12, df = 6, 70; $P < 0.01$). Highest counts occurred in segments that had greater vegetative and physical variety (e.g., Alturas de Santa Clara and Peniplano de Florida-Camagüey-Tunas). Counts were lowest in the plains and cultivated areas. Santana et al. (1986a) also reported fewer vultures in agricultural areas of Puerto Rico. In our surveys calculated density of observed vultures ≤200 m of the road was 0.06/ha (287 440 ha sampled in 11 surveys).

Cuban vulture populations are subject to the same factors that might adversely affect vulture populations in other regions (i.e., habitat modification, chemical pesticides, persecution, and to a lesser extent man-related accidents; reviewed by Wilbur 1983) and should be monitored. We recommend that vulture surveys be conducted at 5–10 yr intervals to detect changes in population levels in Cuba. Roadside count methods appear suitable for these surveys. However, we make the following recommendations for improving survey methods: 1) conduct counts along regular transect routes throughout the year to determine if seasonal fluctuations in numbers are real; 2) if counts vary through the year, survey during low count periods (e.g., January, July, August and October in this study) to exclude possible influx of migrants for a conservative population estimate; 3) conduct surveys between 0900–1200 H and 1400–1700 H on clear days; and 4) conduct more frequent counts which could be completed in a single day.

ACKNOWLEDGMENTS

We thank Mark R. Fuller, David Ellis, Kim Titus, Thomas M. Sweeney, Deborah Davis, and Patricia P. Rabenold for their expert reviews of the manuscript.

LITERATURE CITED

ANDERSEN, D. E., O. J. RONGSTAD AND W. R. MYTTON 1985. Line transect analysis of raptor abundance along roads. *Wildl. Soc. Bull.* 13:533–539.

BROWN, W. H. 1976. Winter population trends in the Black and Turkey Vultures. *Am. Birds* 30:909–912.

DAVIS, D. E. 1941. Notes on Cuban birds. *Wilson Bull* 53:37–40.

DOD, A. S. 1978. Aves de la República Dominicana. Museo Nacional Historia Natural, Santo Domingo, República Dominicana. 332 pp.

ELLIS, D. H., R. L. GLINSKI, J. G. GOODWIN, JR. AND W. H. WHALEY. 1983. New World vulture counts in Mexico, Central America, and South America. Pages 124–133. *In* S. R. Wilbur and J. A. Jackson, EDS. Vulture biology and management. Univ. Calif. Press, Berkeley. 550 pp

FULLER, M. R. AND J. A. MOSHER. 1981. Methods of detecting and counting raptors: a review. Pages 235–246. *In* C. J. Ralph and J. M. Scott, EDS. Estimating numbers of terrestrial birds. Stud. Avian Biol. 6. 630 pp.

——— AND ———. 1987. Raptor survey techniques. Raptor Management Techniques Manual, Nat. Wildl. Fed., Washington, DC.

GARRIDO, O. H. AND F. GARCIA MONTAÑA. 1975. Catálogo de las aves de Cuba. Acad. Ciencias Cuba, La Habana. 149 pp.

HUBBARD, J. P. 1983. Roadside raptor counts as an indicator of the status of the Turkey Vulture in New Mexico. Pages 375–384. *In* S. R. Wilbur and J. A. Jackson, EDS. Vulture biology and management. Univ. Calif. Press, Berkeley. 550 pp.

INSTITUTO CUBANO DE GEODESIA Y CARTOGRAFÍA. 1978. Atlas de Cuba. La Habana, Cuba. 168 pp.

JACKSON, J. A. 1983. Nesting phenology, nest site selection, and reproductive success of Black and Turkey Vultures. Pages 245–270. *In* S. R. Wilbur and J. A. Jackson, EDS. Vulture biology and management. Univ. Calif. Press, Berkeley. 550 pp.

SANTANA, C. E., G. A. POTTER AND S. A. TEMPLE. 1986a. Status and seasonal pattern of abundance of Turkey Vultures in Puerto Rico. *J. Field Ornithol.* 57:235–238.

———, ——— AND ———. 1986b. Home range and activity patterns of Turkey Vultures in Puerto Rico. *Caribb. J. Sci.* 22(3–4):175–177.

WEBSTER, F. S., JR. 1975. South Texas region. *Am. Birds* 29:711–714.

———. 1978. South Texas region. *Am. Birds* 32:373–375.

WETMORE, A. 1916. Birds of Porto Rico. U.S. Dept. Agric. Bull. No. 326.

WILBUR, S. R. 1983. The status of vultures in the Western Hemisphere. Pages 113–123. *In* S. R. Wilbur and J. A. Jackson, EDS. Vulture biology and management Univ. Calif. Press, Berkeley. 550 pp.

ZAR, J. H. 1974. Biostatistical analysis. Prentice-Hall, Inc., Englewood Cliffs, NJ. 620 pp.

Address of first author: Calle K no. 15016 e/7 y D Altahabana, Ciudad de La Habana, 8, Cuba. Address of second author: U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, MD 20708. Mailing address of second author: California Research Station, 2291-A Portola Road, Suite 300, Ventura, CA 93003.

Received 6 July 1987; accepted 5 November 1987